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STANDARDS DEVELOPMENT BRANCH/OMOE
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SURVEY REPORT

AIR QUALITY SURVEY (TAGA)

PPM CANADA INC.

(PCB DESTRUCTION)

RELIANCE ELECTRIC

STRATFORD, ONTARIO

SEPTEMBER, 1987

ARB-162-87

FEBRUARY 1988

TD
883.7
C36
S87
1988
MOE

Ontario

Ministry of the Environment

E. PICHÉ, Director
Air Resources Branch

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Survey Report

Air Quality Survey (TAGA)
PPM Canada Inc. (PCB Destruction)
Reliance Electric, Stratford, Ontario
September, 1987

ARB-162-87

-prepared for-

The Southwest Region
Ontario Ministry of the Environment

-prepared by-

Gary B. De Brou
Senior Scientist
Air Resources Branch

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Table of Contents

	Page No.
Executive Summary	2
1.0 Introduction	3
2.0 TAGA Technologies and Survey Strategy ...	4
3.0 Results and Discussion	5
Appendix A: TAGA Methodology for PCB Monitoring	8
Appendix B: Meteorological Data: Mobile TAGA Station	18

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Executive Summary

On September 18, 1987, the mobile TAGA (3000) unit of the Air Resources Branch conducted an air monitoring survey at Reliance Electric in Stratford, Ontario. The survey objective was to monitor the air downwind of PPM's mobile PCB destruction unit and determine if the destruction process lead to contamination of the surrounding air with PCBs. PPM Canada Inc. decontaminated about 2000 litres of transformer oil containing 61 ppm of PCBs. The TAGA unit provided on-site monitoring for selected PCBs during the entire destruction procedure.

A total of 150 2-minute air samples was screened for selected PCBs. None of the 10 1/2-hour averaged concentrations (computed from the 2-minute samples) exceeded the Ministry guideline of 0.45 ug/m^3 for a 1/2-hour average. In fact, PCBs were not detected during any of the monitoring periods including the background samples. The average detection limits for the TAGA were 0.12 ug/m^3 for total (di-, tri-, tetra- and pentachlorobiphenyl) PCBs.

Résumé

Le 18 septembre 1987, une analyse atmosphérique a été effectuée à la société Reliance Electric de Stratford, en Ontario, à l'aide de l'unité mobile d'analyse des gaz atmosphériques à l'état de trace (modèle 3000) de la Direction des ressources atmosphériques. L'objectif de cette étude était d'analyser l'air sous le vent par rapport à l'unité mobile de destruction de BPC de la société PPM et de vérifier si le processus de destruction polluait l'air ambiant par les BPC. PPM Canada Inc. a décontaminé environ 2 000 litres d'huile pour transformateur contenant 61 ppm de BPC. L'analyseur des gaz atmosphériques à l'état de trace a permis de surveiller sur place certains BPC tout au long du processus de destruction.

Au total, on a examiné 150 échantillons atmosphériques prélevés sur une période de 2 minutes en vue de détecter la présence de certains BPC. Aucune des dix concentrations moyennes réparties sur une demi-heure (calculées à partir des échantillons prélevés sur 2 minutes) ne dépassait la limite recommandée par le Ministère, c'est-à-dire 0,45 ug/m^3 en moyenne sur une demi-heure. En fait, on n'a détecté de BPC lors d'aucune période de surveillance et dans aucun échantillon de fond. La limite moyenne de détection de l'analyseur était de 0,12 ug/m^3 pour tous les BPC (dichlorobiphényles, trichlobiphényles, tétrachlorobiphényles et pentachlorobiphényles).

1.0 Introduction

At the special request of the Southwest Region of the Ontario Ministry of the Environment the Trace Atmospheric Gas Analyser (TAGA 3000) unit conducted a mobile ambient air survey in Stratford, Ontario on September 18, 1987. The purpose of the survey was to provide, on-site, ambient concentration measurements of selected PCBs during the decontamination of transformer oil containing PCBs located at Reliance Electric.

PPM Canada Inc. was contracted to decontaminate nine barrels of mineral oil (approximately 2000 litres) containing 61 ppm of PCBs. The process utilized by PPM is based on the well-known reaction of metallic sodium and chlorinated biphenyls to yield biphenyls and sodium chloride. The reaction proceeds until the concentration of PCBs in the oil is reduced to less than 2 ppm, a level well below the Ministry of the Environment's PCB contamination guideline of 50 ppm. During normal operation, gaseous emissions (mainly nitrogen) from the reaction vessel and storage tank are vented via a short pipe through a charcoal filter and oil de-mister.

The mobile TAGA unit was present on September 18, 1987 during the entire PCB decontamination process: from the time when the oil was first transferred to the reaction vessel to the time when the reaction was complete and the PCB level in the oil was less than 2 ppm. The monitoring results, which were obtained every 2 minutes, were conveyed by the TAGA scientists to the Ministry's London office via Mr. Lloyd Zinger and Mr. Glen Grosse, both of whom were on-site during the survey. In accordance with the Certificate of Approval issued to PPM, had the airborne levels of PCBs determined by the TAGA exceeded the background levels (determined just prior to PPM commencing the operations), PPM would have been required to cease operations until the reason for PCB presence had been determined and rectified.

This report summarizes the findings of the Stratford survey and presents the unique analytical protocol used by the TAGA unit to obtain near real-time measurement of gaseous PCBs.

2.0 TAGA Technology and Survey Stategy

A detailed description of PCB monitoring technique is provided in Appendix A. Briefly, the TAGA (model 3000) is a specialized mass spectrometer (MS) with a unique ion source based on the principle of atmospheric pressure chemical ionization (APCI). The system design permits direct analysis of air samples in the real-time for a broad range of airborne pollutants.

To monitor ambient PCBs, the APCI ion source is coupled to an Automated Short Term Adsorber (ASTA) which is a sample preconcentrator and thermal desorption unit. The TAGA/ASTA technique provides ambient PCB measurements continuously every 2 minutes. Half-hour averaged concentrations of PCBs are determined by simply computing the arithmetic mean of 15 2-minute averaged concentrations. For this particular survey, the air was screened for the di-, tri-, tetra-, and pentachlorobiphenyl isomer groups.

The survey strategy for this study was to position the mobile TAGA unit, as close as possible, downwind of the PPM mobile destruction unit and monitor the air for selected PCBs. The readings, which were obtained every 2 minutes, were then compared to previously determined background data. Background data was determined upwind of the destruction site a few hours prior to PPM setting up their unit. In addition, background levels were ascertained downwind of PPM just before the PCB-containing oil was pumped into the reaction vessel. Finally, during the actual destruction process, monitoring by the TAGA proceeded for several hours until the oil was decontaminated to less than 2 ppm. Since the monitoring results were known within minutes of the sampling periods, Ministry personnel evaluated the data on-site, and determined if PPM should be permitted to proceed.

The TAGA was calibrated for PCB detection before and during the PCB destruction process. Calibration and background data were used to calculate the detection limit, which is defined as 3 times the standard deviation of the background signal, recorded at the PCB target masses, divided by the sensitivity factors per unit concentration (mean 0.12 ug/m^3). For September 18, 1987 the detection limits for the (TAGA) analytical technique were computed to be 0.07 ug/m^3 to 0.17 ug/m^3 for total PCBs monitored.

3.0 Results and Discussion

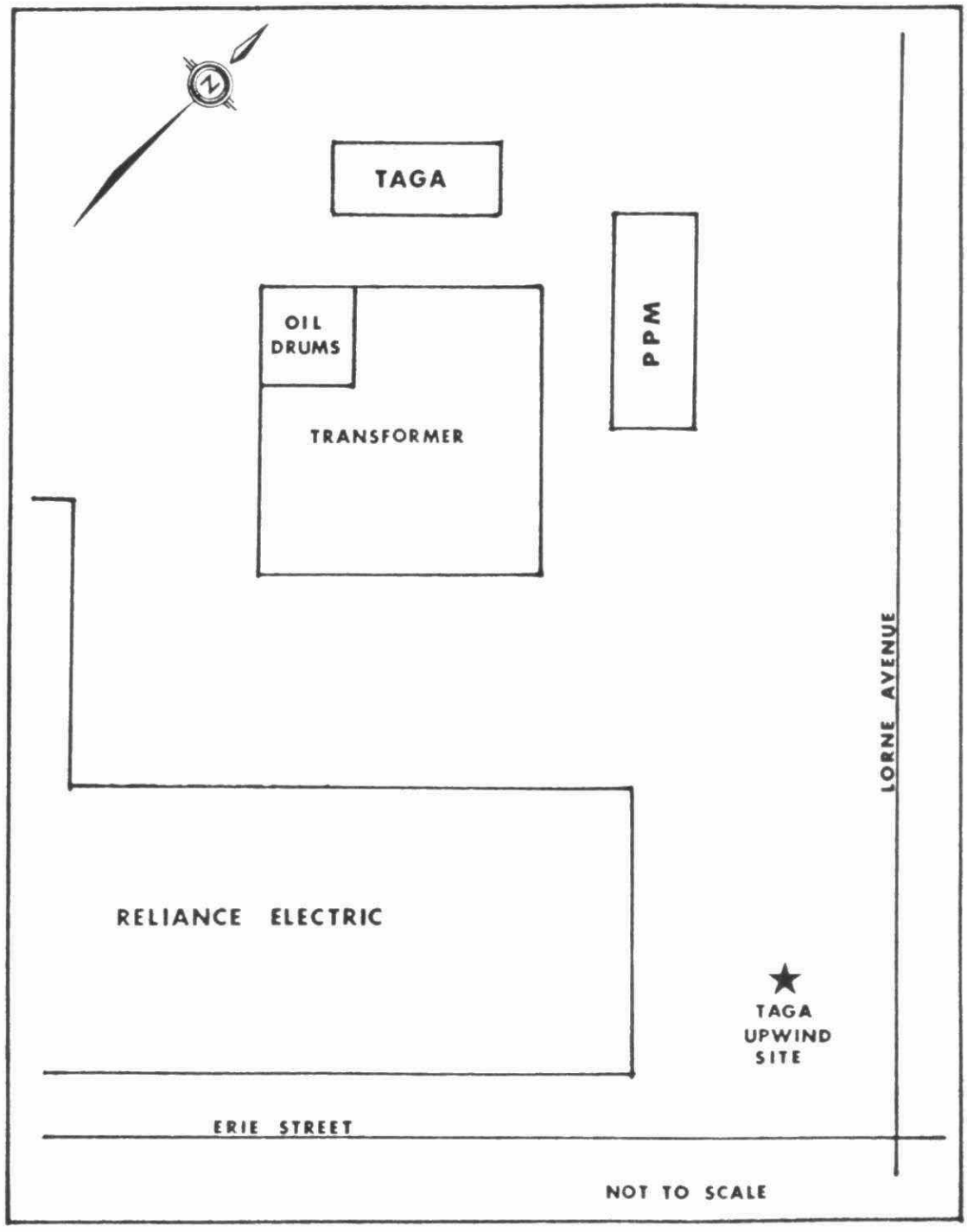
On September 18, 1987 between the period of 14:00 hours and 19:00 hours PPM Canada Inc. successfully decontaminated roughly 2000 litres of transformer oil containing 61 ppm of PCBs. The mobile TAGA (3000) unit was present during the entire destruction process and provided near real-time measurements of selected PCBs in the surrounding air. The meteorological conditions were ideal for the monitoring sites: light to moderate winds consistently out of the east. The sampling site for the downwind measurements was only 10 metres from the destruction site. Moreover, this site was downwind of the PPM mobile unit and the PCB oil storage area (See Map 1). The meteorological data acquired by the mobile TAGA unit are presented in Appendix B.

Including background monitoring, a total of 150 2-minute air samples were analysed on-site for PCBs (di- to pentachlorobiphenyls). The survey results are summarized in Table 1. Fifteen consecutive 2-minute samples were averaged to yield the 1/2-hour averaged concentrations which could be compared to the Ministry Guideline of 0.45 ug/m^3 for a 1/2-hour averaged concentration.

As shown in Table 1, PCBs were not detected during any of the monitoring periods. All (10) of the 1/2-hour averaged concentrations for PCBs were below the analytical detection limits. The TAGA did not register PCBs in the background samples nor in any of the downwind samples. Note that measurements for ambient PCBs were made during the potentially critical times, when the contaminated oil was pumped into the reaction vessel and during the addition of the highly reactive sodium emulsion.

The detection limits of the TAGA technique for this survey, averaging 0.12 ug/m^3, ranging from 0.07 to 0.17 ug/m^3. The TAGA was calibrated for PCB detection twice during the day: at 12:30 hours prior to start-up at the upwind location, and at 17:30 hours at the downwind monitoring site.

The survey ended shortly after 19:30 hours, after PPM had successfully reduced the PCB level in the oil to less than 2 ppm. Since at no time were PCBs detected in the air by the TAGA, it is concluded that the PPM operation was safe. The findings were in agreement with the results of the `Florisil' cartridge samples acquired by the Southwest Region. Three air samples were collected at three sites around the PCB destruction unit: 30 metres upwind; 15 metres downwind; and from the roof of the mobile TAGA unit. Following completion of the PCB destruction process, the cartridge samples were returned to the Ministry's Lab Services Branch for Gas Chromatographic (GC) analysis. None of these air samples contained PCBs above the detection limits of 0.8 ng/m^3.



Map 1: Monitoring Sites for Mobile TAGA Unit
Stratford Survey, September 1987

Table 1
TAGA PCB Survey: PPM Canada Inc.
Reliance Electric, Stratford, September 18, 1987

Sample	Start[1] Time	Meteorology[2] WS	WD	AT	1/2-Hour[3] Average	Comments
1	11:13	10-15	E	12	ND	upwind, visitors P.L., prior to PPM setup
2	11:45	10-15	E	12	ND	upwind, visitors P.L., prior to PPM setup
3	13:39	5-10	E	15	ND	downwind of destruction site, prior to start-up
4	14:18	5-10	ENE	15	ND	downwind of PPM, transferring PCB/oil from drums
5	14:50	5-10	ENE	14	ND	downwind of PPM, Na added to PCB/oil
6	15:25	8-15	ENE	14	ND	downwind of PPM, destruction on-going
7	15:57	7-15	ENE	14	ND	downwind of PPM, destruction on-going
8	16:56	7-20	E	13	ND	downwind of PPM, destruction on-going
9	18:22	0-15	E	13	ND	downwind of PPM, destruction on-going
10	18:54	5-11	E	13	ND	downwind of PPM, oil decontaminated, <2ppm

Notes:
1. Start time refers to the start of adsorption time of the first sample.
2. WS = wind speed range (km/hr); WD = predominant wind direction; AT = ambient temperature (°C)
3. 1/2-hour concentration of gaseous PCBs (di- to pentachlorobiphenyls); mean of 15 2-minute samples. ND = not detected.

Appendix A ... TAGA Methodology for PCB Monitoring

TAGA METHODOLOGY

In 1979 the Air Resources Branch of the Ontario Ministry of the Environment acquired a mobile Trace Atmospheric Gas Analyzer (TAGA 3000) manufactured by Sciex Incorporated of Thornhill, Ontario. The mobile TAGA unit (MAMU No. 3) has been applied to a variety of air monitoring situations, including airborne PCBs. The Ministry has conducted over 50 air quality surveys with the mobile TAGA unit.

The TAGA 3000 is a highly specialized quadrupole mass spectrometer coupled to a unique sampling inlet and ion source (See Figure A1). Ionization of pollutants is achieved through chemical ionization, initiated by a stable corona discharge operating at atmospheric pressure. Since the ion source permits continuous, direct, air sampling at a high flow rate (100 l/min), it is possible to determine the temporal and spatial distribution of selected pollutant levels. The mobile TAGA's capabilities are especially suitable for plume tracking; that is, tracing a pollutant back to its source of origin.

When equipped with the standard atmospheric-pressure chemical ionization (APCI) source the TAGA system is sensitive to most volatile compounds containing a heteroatom, such as N,O,S,P and halide. Typical detection limits are in the range of 0.1 to 10.0 ug/m^3 depending on the type of chemical measured and the sample matrix.

The mobile TAGA unit is also equipped with a 10 metre, telescopic tower and meteorological instrumentation to measure local wind speed, wind direction and ambient temperature. All meteorological data are stored by the on-board computer simultaneously with the collection of air quality data. The data are instantly displayed on the CRT unit allowing the operator to assess the data on-site and thus formulate the appropriate survey strategy.

PCB MONITORING METHODOLOGY

For most chemical classes the sensitivity of the TAGA is extraordinary for ambient air monitoring. However PCBs are one of the exceptions, because the absolute sensitivity is insufficient for instantaneous real-time detection relative to the low guideline set by the Ministry for PCBs (0.45 ug/m^3). Thus in the late 1970's Sciex Inc. developed a simple sampling device to preconcentrate volatile PCBs. Preconcentrating the PCBs for only 2-minutes lowers the detection limit by two orders of magnitude.

Although the basic principles have remained unchanged, today's PCB preconcentrator has evolved into a portable sampling inlet system with all operating parameters under strict computer control. It is commercially known as the Automated Short Term Adsorber or ASTA.

The ASTA, shown in Figure A2, consists of two sample probes formed by coiling a nichrome wire, coated with a gas chromatographic stationary phase, OV-17. The positions, and thus functions of the two probes, are interchangeable between the adsorption or sampling position, and the desorption or analysis position. While one probe is adsorbing PCBs from the ambient air, the other probe is being desorbed and analysed for PCBs from a previous air sample. Altering the positions of the two probes permits continuous screening of the ambient air in 2 minute intervals. There is approximately an eight second delay between sampling periods due to the probe cycling time. Thus a "1/2-hour sample", which consists of 15 consecutive 2 minute samples, takes 32 minutes.

Sampling

When sampling for PCBs the probe is placed directly in the ambient air stream (1.7 l/s) for a period of 2 minutes. The probe is then changed to the desorb position and 12 volts DC potential (3.25 amperes) is applied to the probe for a period of 40 seconds. This causes the probe temperature to rapidly increase to approximately 300 °C, thereby transferring the PCBs from the OV-17 into the gas phase. The carrier gas, which is a mixture of ultra pure zero air and benzene (100 ppm), constantly sweeps the PCBs into the ion source. Upon entering the ion source the PCBs immediately undergo benzene chemical ionization, producing molecular PCB ions (M+) which are (mass) selectively monitored by the quadrupole mass filter.

The software allows for the screening of 4 PCB isomer groups at 8 masses, 2 isotopes per isomer group. Normally the

dichlorobiphenyl to pentachlorobiphenyl species are monitored. There are several reasons for this: firstly, the TAGA is more sensitive to these species. Secondly, PCBs with lower molecular weights generally exhibit higher vapour pressures, thus increasing the likelihood of gas phase detection; and, thirdly, in previous PCB surveys the higher molecular weight PCBs were rarely detected when the lower molecular weight PCBs were not observed.

Calibration

Calibration of the system, including sampling probe adsorption efficiencies and TAGA response, is accomplished by continuously injecting known amounts of PCBs directly into the air sampling stream. The PCBs are injected via a heated injection port (300 °C) using a gas-tight syringe and motorized syringe drive. The PCB standards are prepared by the dissolution of pure PCB congeners, one per isomer group, into iso-octane. Repeated injections at 5 different syringe drive settings establishes a calibration curve which is linear (correlation coefficients are usually better than 0.995) over the PCB concentration range of 0.425 to 2.50 ug/m^3 per isomer group (See Figure A3). The relative standard deviations for multiple injections of PCB standards are typically better than 5% at the 0.425 ug/m^3 level.

DATA PROCESSING AND INTERPRETATION

Immediately following a desorption of the probe, the TAGA computer calculates the level of PCBs (or equivalents) per isomer group, from the net signal (sample minus background) and the daily calibration factors. In fact, for each PCB isomer group, two measurements are made: one for the chlorine 35 isotope (M), and one for the corresponding chlorine 37 isotope (M+2).

Criteria

At this stage the field survey scientist interprets the reduced data using the following criteria:

1) the adsorption peak (integrated signal) must be as least 3 times greater than the signal noise (S/N>3);

2) the PCB levels for a given isotope pair must be within the overall experimental accuracy of 20%;

3) the calculated isotope ratios must be within 10% of the theoretical isotope ratio for a given isomer group.

If condition 1) above is not satisfied, the isomer group concentration will be considered below the detection limit and a ND is reported. If conditions 2) and 3) are not evident then a chemical interference at one, or both, of the isomer groups is assumed to be present, and the lower concentration value of the two isotopes is assigned the upper concentration limit for that particular PCB isomer group. The value is then flagged with the letter "i" indicating that a chemical interference has inflated the reported concentration. An example of a data print-out showing the PCB desorption curves may be seen in Figure A4.

Detection Limit

The PCB detection limit for the TAGA/ASTA technique is defined as being 3 times the standard deviation of the background signal observed at the PCB masses, divided by the appropriate calibration factors. Thus by definition, the detection limit depends on two important factors:

i) the sensitivity, which is a function of the probe adsorption efficiencies and the benzene chemical ionization rates.

ii) the level of the interferences (adsorbed compounds that have the same nominal ionic mass as the targeted PCBs in both upwind and downwind air samples). Interference

levels are highly variable depending on the sampling site, the source(s) in the immediate area, and the local meteorological conditions.

During a survey air samples are spiked periodically with 0.425 ug/m^3 per PCB isomer group to establish the daily sensitivity factors and determine, on-site, the detection limits of the technique. Typical detection limits range from 0.01 to 0.05 ug/m^3 per isomer group, or from 0.04 to 0.2 ug/m^3 for total (di to pentachlorobiphenyls) PCBs, depending on the complexity of the sample matrix.

SUMMARY

The TAGA/ASTA PCB monitoring technique is a specialized application of the mobile TAGA 3000. It was developed to rapidly screen the ambient air for volatile PCBs. Important features of the technique to consider when assessing the data are:

1) The technique was developed to measure gas phase PCBs. (Should non-volatile PCBs be trapped by the probe they would be reported as volatile PCBs and included in the total amounts.)

2) PCB levels are determined continuously in 2 minute periods.

3) Four isomer groups are monitored simultaneously (normally the dichlorobiphenyls to pentachlorobiphenyls).

4) The detection limits for total PCBs typically range from 0.04 to 0.2 ug/m^3 depending on the sample matrix.

In summation, the mobile TAGA/ASTA technique is a rapid screening method for volatile PCBs, providing near real-time detection at the time when PCBs are potentially released into the atmosphere. It is the only method currently available to the Ministry by which the ambient air can be instantaneously scanned for PCBs, providing valuable information, on-site.

TAGA 3000 SYSTEM

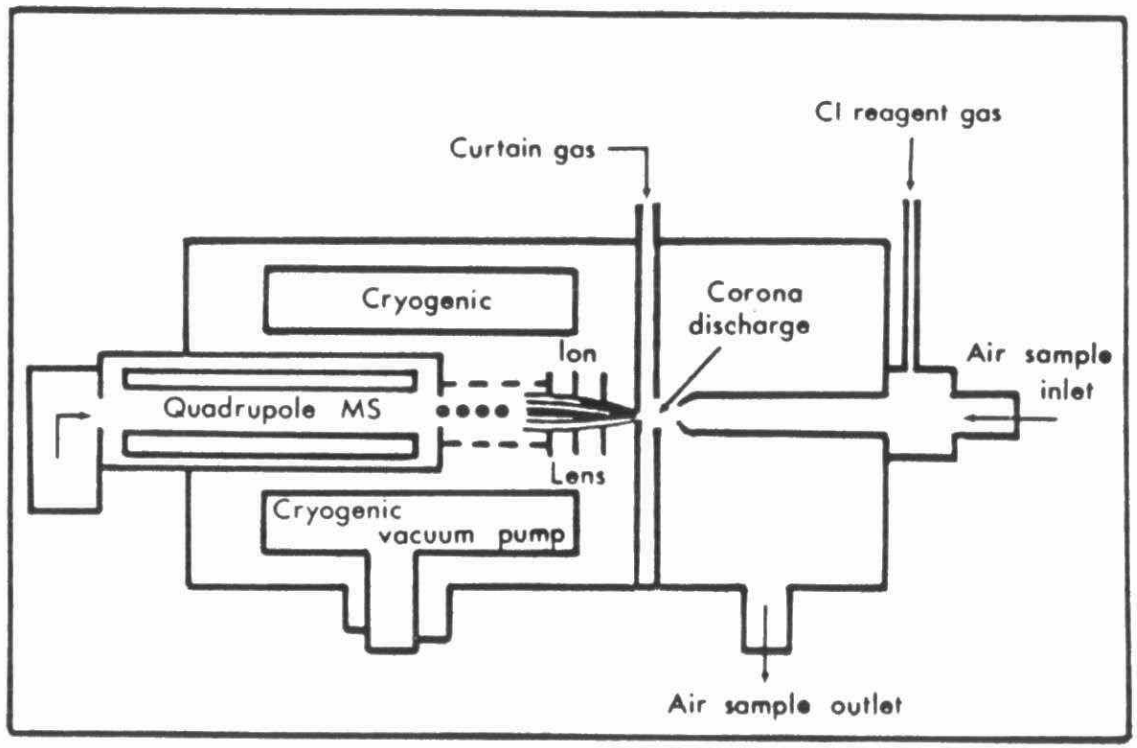


FIGURE A1: SCHEMATIC OF THE TAGA 3000 SYSTEM INSTALLED IN MAMU #3

ASTA SCHEMATIC

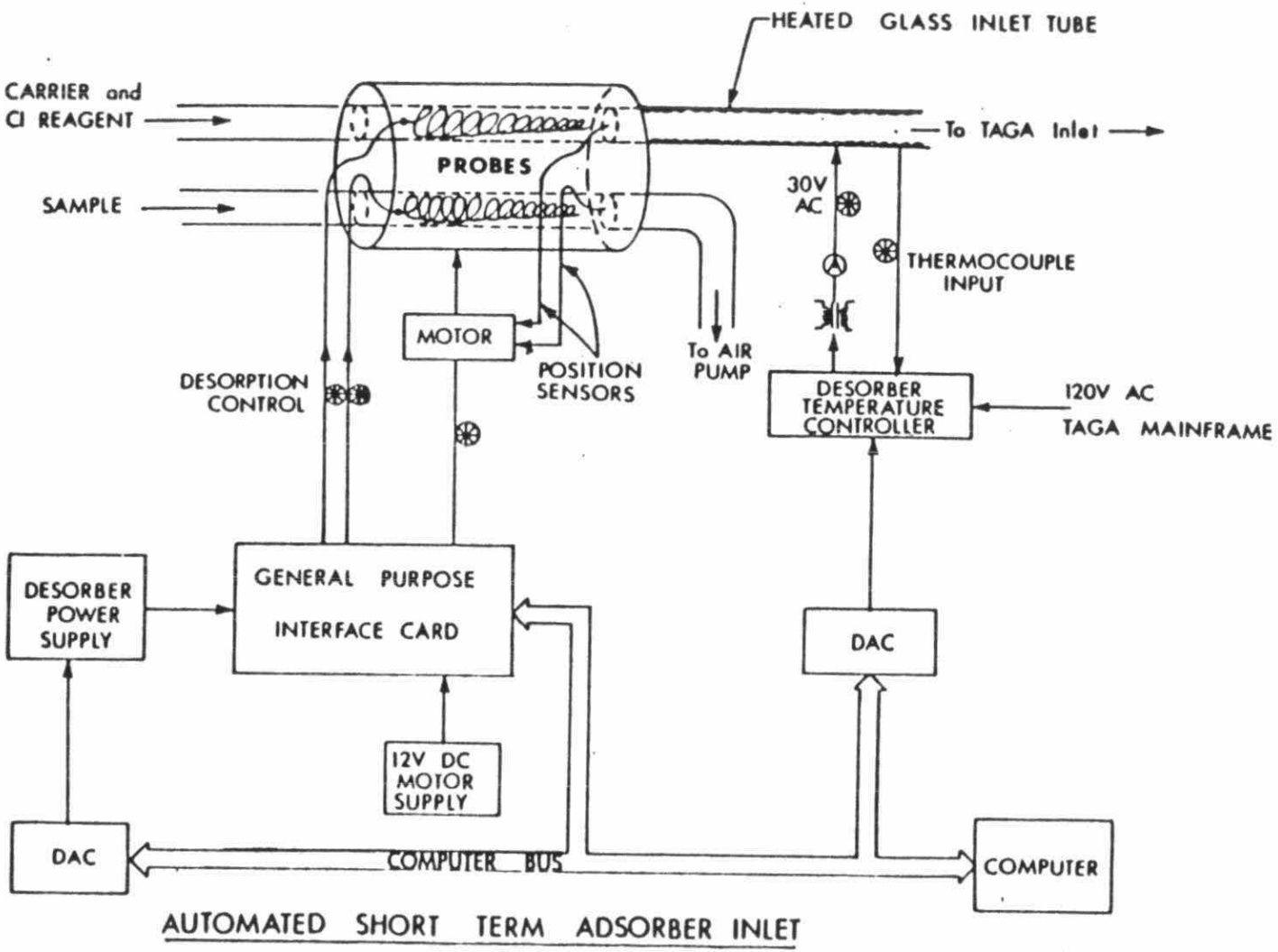


Figure A2: Schematic of the ASTA used in conjunction with the TAGA PCB Monitoring technique.

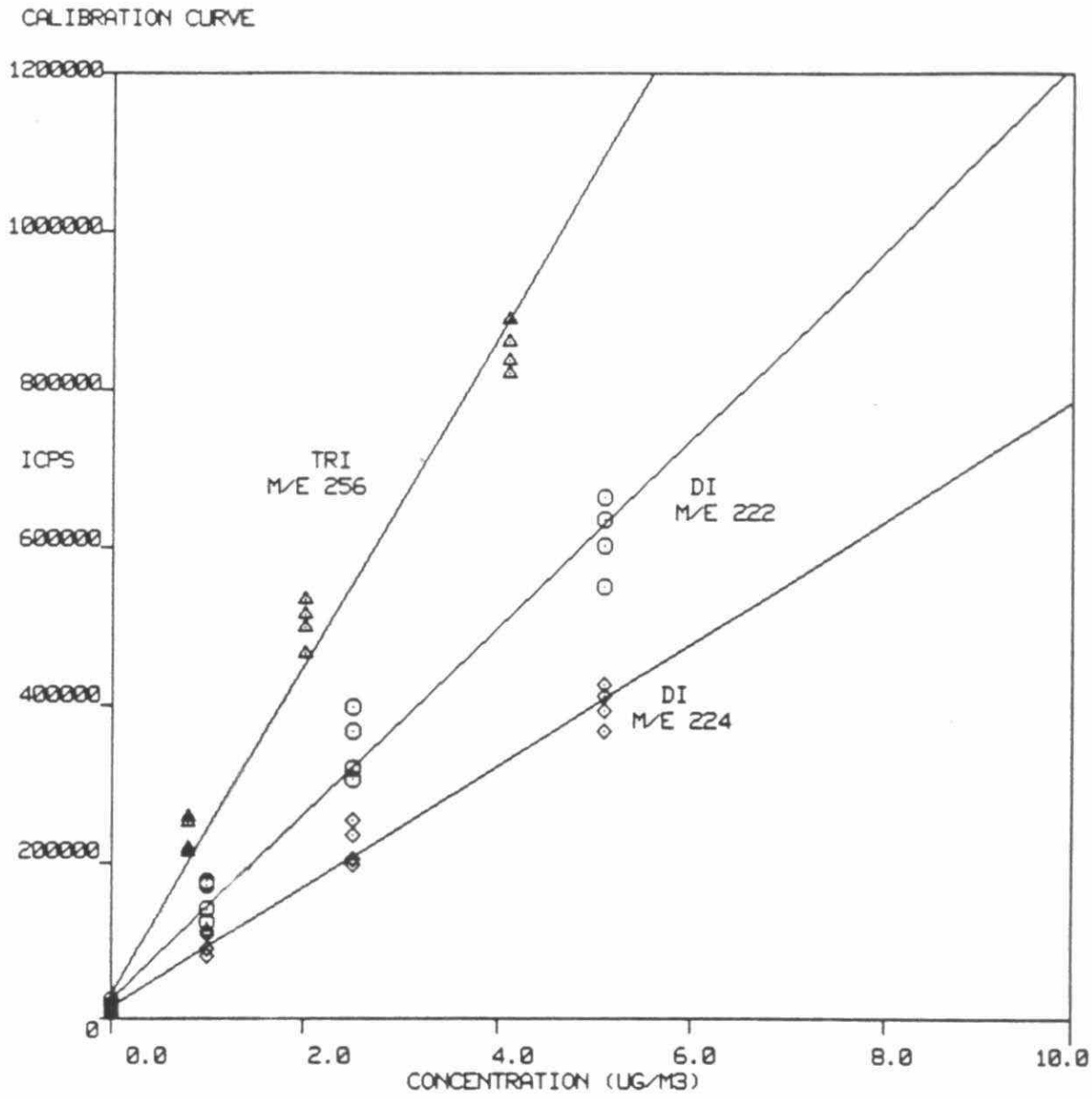
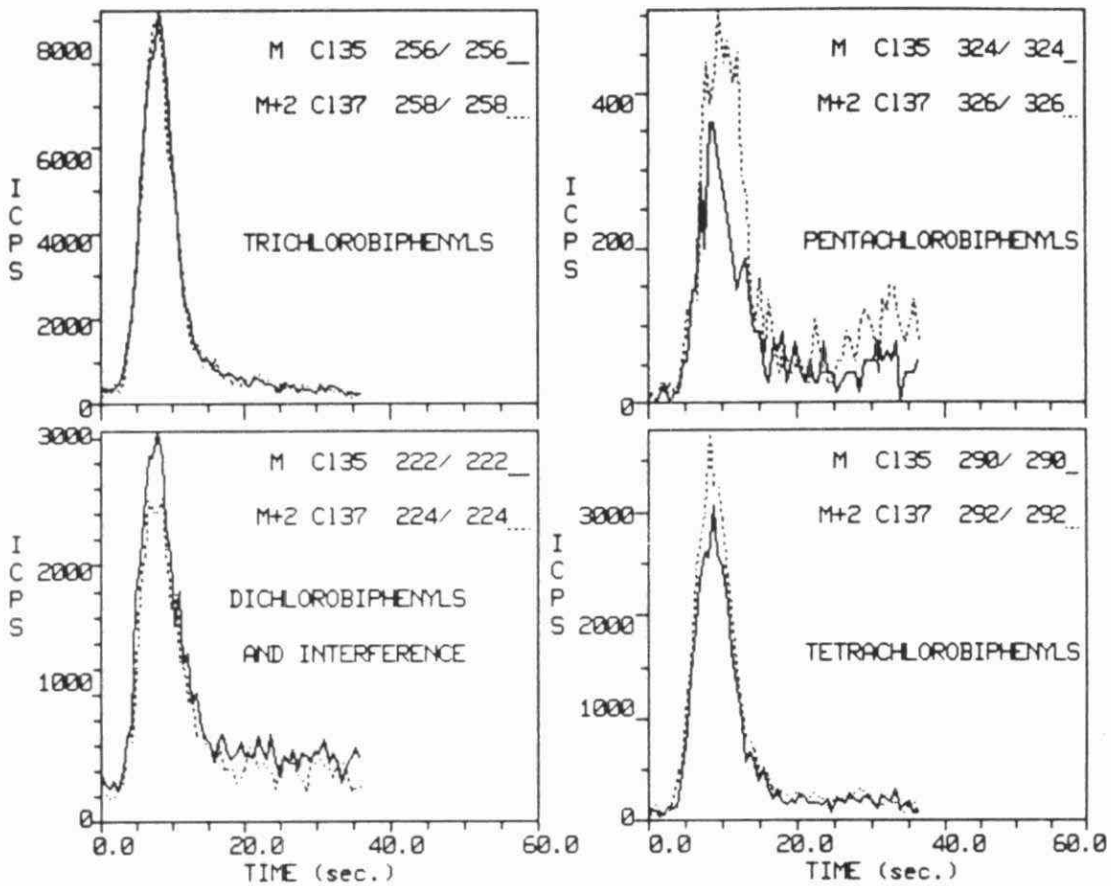


FIGURE A3: EXAMPLE OF CALIBRATION CURVE FOR DI AND TRICHLOROBIPHENYLS

TAGA/ASTA MONITORING TECHNIQUE



MP/MD	MAX.INT	TIM.MAX	INT.IONS	NET	CONC	RATIO TO MP/MD		THEOR.
222/ 222	3053.	8.40	17143.	14691.	0.39i	1.283	224/ 224	1.540
224/ 224	2520.	9.12	13994.	11452.	0.47i	0.780	222/ 222	0.650
256/ 256	9213.	8.56	46335.	43368.	0.60	1.056	258/ 258	1.030
258/ 258	8906.	8.64	43545.	41069.	0.62	0.947	256/ 256	0.975
290/ 290	3067.	9.36	14284.	12730.	0.23	0.818	292/ 292	0.769
292/ 292	3800.	8.80	17271.	15562.	0.23	1.222	290/ 290	1.300
324/ 324	360.	9.52	1707.	1303.	0.10	0.620	326/ 326	0.615
326/ 326	507.	10.24	2662.	2099.	0.11	1.612	324/ 324	1.626
					1.3			

FIGURE A4: Example of TAGA data print-out, PCB analysis. Concentrations are in units of ug/m3. Note the ratio for isotope 222/224 dichlorobiphenyl is mismatched, where "i" denotes a contribution by interference at masses 222 and/or 224. The total PCB level is computed to be 1.3 ug/m3.

Appendix B ... Meteorological Data: TAGA Station

STRATFORD

Start: 87/09/18 10:43:00 File: ST1801.MET
Scan : 30 sec Ave: 5.00 min Rep: 5.00 min Rnd: 5.0 min
Loc : VISITOR PL OF RE, NEAR RECEPTION ENTRANCE.
Met : OVERCAST

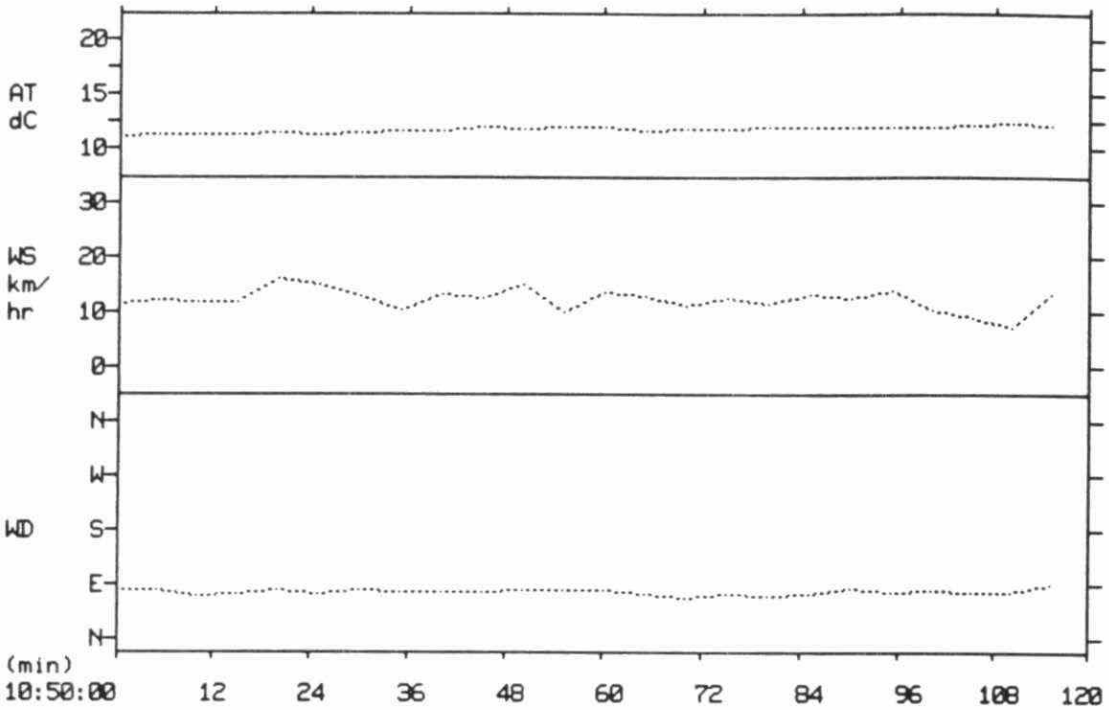
— Time —	Temp d C	W-Spd km/hr	W-Dir deg
10:45:00 - 10:50:00	11.3	11.7	79.
10:50:00 - 10:55:00	11.4	12.5	79.
10:55:00 - 11:00:00	11.4	12.0	72.
11:00:00 - 11:05:00	11.4	12.1	74.
11:05:00 - 11:10:00	11.5	16.3	81.
11:10:00 - 11:15:00	11.5	15.2	73.
11:15:00 - 11:20:00	11.5	13.4	81.
11:20:00 - 11:25:00	11.7	10.6	79.
11:25:00 - 11:30:00	11.9	13.4	78.
11:30:00 - 11:35:00	12.1	12.9	77.
11:35:00 - 11:40:00	12.1	15.3	79.
11:40:00 - 11:45:00	12.2	10.2	80.
11:45:00 - 11:50:00	12.1	14.0	80.
11:50:00 - 11:55:00	11.8	13.2	74.
11:55:00 - 12:00:00	11.9	11.4	67.
12:00:00 - 12:05:00	12.0	13.0	74.
12:05:00 - 12:10:00	12.1	11.8	71.
12:10:00 - 12:15:00	12.1	13.6	75.
12:15:00 - 12:20:00	12.1	12.8	83.
12:20:00 - 12:25:00	12.2	14.4	78.
12:25:00 - 12:30:00	12.2	10.9	79.
12:30:00 - 12:35:00	12.3	9.3	78.

Continue: [Y/N] > _

```
12:20:00 - 12:25:00      12.2      14.4        78.
12:25:00 - 12:30:00      12.2      10.9        79.
12:30:00 - 12:35:00      12.3       9.3        78.
Continue: [Y/N] > Y
STRATFORD                      - File: ST1801.MET                Page:  2

— Time —                 Temp     W-Spd      W-Dir
                         d C      km/hr        deg

12:35:00 - 12:40:00      12.4       7.6        76.
12:40:00 - 12:45:00      12.4      13.6        89.
Continue: [Y/N] > Y
STRATFORD                      - File: ST1801.MET                Page:  3

                         Temp     W-Spd      W-Dir
                         d C      km/hr        deg

Arith. Mean              11.9         -          -
Std. Dev.                 0.4         -          -
Min. Reading             11.3       3.8        45.
Max. Reading             12.7      22.1        97.
Min. Average             11.3       7.6        67.
Max. Average             12.4      16.3        89.
# Valid Rdgs              246.      246.       246.


  -   Invalid Data / Not Calculated
  m   One or more readings Missing

Percent Valid Data Required for Valid Average:  75.0 %
Averaging Started at Nearest:                    5.0 min


Do you want graphical output? [Y/N] _
```

STRATFORD

Start: 87/09/18 10:43:00 File: ST1801.MET
Scan : 30 sec Ave: 5.00 min Rep: 5.00 min Rnd: 5.0 min
Loc : VISITOR PL OF RE, NEAR RECEPTION ENTRANCE.
Met : OVERCAST



STRATFORD:LORNE AVE

Start: 87/09/18 13:05:00 File: ST1802.MET
Scan : 30 sec Ave: 5.00 min Rep: 5.00 min Rnd: 5.0 min
Loc : DW OF PPM DESTRUCTION UNIT. NEXT TO PCB CONTAMINATED OIL.
Met : OVERCAST AND COOL

— Time —	Temp d C	W-Spd km/hr	W-Dir deg
13:05:00 - 13:10:00	13.7	12.8	75.
13:10:00 - 13:15:00	13.8	11.3	64.
13:15:00 - 13:20:00	13.7	11.2	76.
13:20:00 - 13:25:00	14.0	12.2	71.
13:25:00 - 13:30:00	14.0	11.3	100.
13:30:00 - 13:35:00	14.1	9.6	99.
13:35:00 - 13:40:00	14.3	10.3	82.
13:40:00 - 13:45:00	14.5	10.4	77.
13:45:00 - 13:50:00	14.6	7.5	93.
13:50:00 - 13:55:00	14.4	10.4	100.
13:55:00 - 14:00:00	14.6	8.0	77.
14:00:00 - 14:05:00	14.7	9.2	97.
14:05:00 - 14:10:00	14.6	7.5	84.
14:10:00 - 14:15:00	14.6	7.4	73.
14:15:00 - 14:20:00	14.7	5.8	106.
14:20:00 - 14:25:00	14.6	4.3	70.
14:25:00 - 14:30:00	14.5	7.4	72.
14:30:00 - 14:35:00	14.8	7.2	81.
14:35:00 - 14:40:00	14.8	5.4	98.
14:40:00 - 14:45:00	14.8	6.5	76.
14:45:00 - 14:50:00	14.6	8.0	72.
14:50:00 - 14:55:00	14.3	5.6	61.

Continue: [Y/N] > _

STRATFORD:LORNE AVE - File: ST1802.MET Page: 2

-- Time --	Temp d C	W-Spd km/hr	W-Dir deg
14:55:00 - 15:00:00	14.5	7.1	76.
15:00:00 - 15:05:00	14.5	7.1	91.
15:05:00 - 15:10:00	14.4	7.9	61.
15:10:00 - 15:15:00	14.3	7.5	89.
15:15:00 - 15:20:00	14.3	7.9	89.
15:20:00 - 15:25:00	14.3	8.8	97.
15:25:00 - 15:30:00	14.2	9.5	86.
15:30:00 - 15:35:00	14.2	11.3	65.
15:35:00 - 15:40:00	14.2	12.0	73.
15:40:00 - 15:45:00	14.1	12.7	65.
15:45:00 - 15:50:00	14.0	12.2	65.
15:50:00 - 15:55:00	14.2	7.5	75.
15:55:00 - 16:00:00	14.4	9.5	76.
16:00:00 - 16:05:00	14.2	9.9	59.
16:05:00 - 16:10:00	13.9	11.4	67.
16:10:00 - 16:15:00	14.2	11.0	73.
16:15:00 - 16:20:00	14.4	10.2	71.
16:20:00 - 16:25:00	14.3	13.4	72.
16:25:00 - 16:30:00	14.1	10.1	62.
16:30:00 - 16:35:00	13.7	13.3	59.
16:35:00 - 16:40:00	13.6	13.6	70.
16:40:00 - 16:45:00	13.7	11.8	72.
16:45:00 - 16:50:00	13.4	8.9	52.
16:50:00 - 16:55:00	13.2	8.9	55.
16:55:00 - 17:00:00	13.4	12.7	77.
17:00:00 - 17:05:00	13.3	13.8	70.
17:05:00 - 17:10:00	13.3	9.4	79.
17:10:00 - 17:15:00	13.3	10.2	64.

Continue: [Y/N] > _

```
17:10:00 - 17:15:00      13.3      10.2        64.
Continue: [Y/N] > Y
STRATFORD:LORNE AVE              - File: ST1802.MET                Page:  3

-- Time --                  Temp      W-Spd      W-Dir
                             d C      km/hr        deg

17:15:00 - 17:20:00      13.4      12.1        75.
17:20:00 - 17:25:00      13.4      15.7        79.
17:25:00 - 17:30:00      13.3      16.7        80.
17:30:00 - 17:35:00      13.5      17.7        87.
17:35:00 - 17:40:00      13.4      14.6        96.
17:40:00 - 17:45:00      13.3      15.0        95.
17:45:00 - 17:50:00      13.1      13.1        78.
17:50:00 - 17:55:00      13.0      11.7        96.
17:55:00 - 18:00:00      12.8      12.7        90.
18:00:00 - 18:05:00      12.8      10.5        97.
18:05:00 - 18:10:00      12.7      11.6       102.
18:10:00 - 18:15:00      12.7      10.6       103.
18:15:00 - 18:20:00      12.7       9.5        96.
18:20:00 - 18:25:00      12.7      10.5       108.
18:25:00 - 18:30:00      12.7      11.1       110.
18:30:00 - 18:35:00      12.7       6.3       108.
18:35:00 - 18:40:00      12.7       6.6       102.
18:40:00 - 18:45:00      12.7       1.6        80.
18:45:00 - 18:50:00      12.7       1.7        79.
18:50:00 - 18:55:00      12.7       2.1        89.
18:55:00 - 19:00:00      12.7       5.7       119.
19:00:00 - 19:05:00      12.7       7.6       114.
19:05:00 - 19:10:00      12.6       8.2       106.
19:10:00 - 19:15:00      12.6       5.8        80.
19:15:00 - 19:20:00      12.6       9.1        82.
19:20:00 - 19:25:00      12.6      11.9        91.
Continue: [Y/N] > _
```

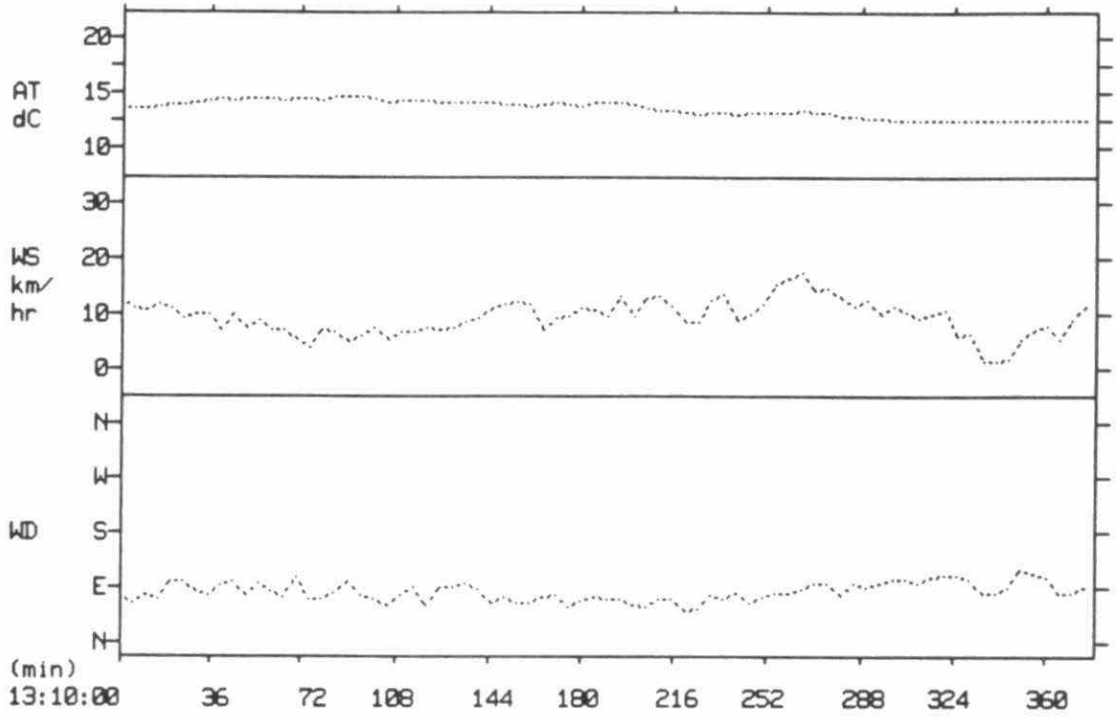
STRATFORD:LORNE AVE - File: ST1802.MET Page: 4

	Temp d C	W-Spd km/hr	W-Dir deg
Arith. Mean	13.7	-	-
Std. Dev.	0.7	-	-
Min. Reading	12.5	0.7	29.
Max. Reading	15.0	25.8	127.
Min. Average	12.6	1.6	52.
Max. Average	14.8	17.7	119.
# Valid Rdgs	768.	768.	768.

- Invalid Data / Not Calculated
m One or more readings Missing

Percent Valid Data Required for Valid Average: 75.0 %
Averaging Started at Nearest: 5.0 min

Do you want graphical output? [Y/N] _

STRATFORD:LORNE AVE

Start: 87/09/18 13:05:00 File: ST1802.MET
Scan : 30 sec Ave: 5.00 min Rep: 5.00 min Rnd: 5.0 min
Loc : DW OF PPM DESTRUCTION UNIT. NEXT TO PCB CONTAMINATED OIL.
Met : OVERCAST AND COOL